Heat Flux Instabilities in the Solar Wind: Full Particle Simulations

J. Wang*, S.P. Gary**, and P.C. Liewer*

* Jet Propulsion Laboratory, California California Institute of Technology, Pasadena

** Los Alamos National Laboratory, Los Alamos, New Mexico

Solar wind electrons are observed often to consist of two components, a core and a much hotter halo. The anisotropies and relative drift of these two components correspond to a heat flux which may excite several electromagnetic instabilities. Previous research has suggested that heat flux instabilities may represent the mechanisms that regulate the flow of thermal energy in the solar wind, and hence are the most plausible explanation of the observed results of solar wind heat flux. However, all previous studies of heat flux instability are based on linear or quasi-linear analysis. The objective of this research is to apply electromagnetic full particle simulations to examine the nonlinear consequences of these instabilities. This paper focuses on the effects of the whistler heat flux instability. We study how pitch-angle scattering from the instability affects the electron distributions and how the instability stabilizes itself. We examine the marginal stability condition, and quantify the electron core heating rate and the heat flux bound.

space
plasma
physics